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Report of Investigations 4828

INVESTIGATION OF KASNA CREEK COPPER PROSPECT, LAKE KONTRASHIBUNA, LAKE CLARK REGION, ALASKA

BY R. S. WARFIELD AND F. A. RUTLEDGE

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UNITED STATES DEPARTMENT OF THE INTERIOR
Oscar L. Chapman, Secretary
BUREAU OF MINES
J. J. Forbes, Director

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by

R. S. Warfield[1] and F. A. Rutledge[1]

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1/ Mining engineer, Bureau of Mines, Juneau, Alaska

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INTRODUCTION AND SUMMARY

The Kasna Creek copper deposit near Lake Kontrashibuna in the Lake Clark region, Alaska, was the object of an investigative project by the Bureau of Mines during the fall of 1948. Recessed because of inclement weather, it was completed in 1949. This project was a part of the Bureau of Mines program in Alaska for the development of critical and strategic minerals.

The ore bodies are contact-replacement deposits in limestone. Mineralization is mainly specular and micaceous hematite associated with chalcopyrite, calcite, chlorite, quartz, and amphibole. The deposit, on the right limit of Kasna Creek approximately 2 miles from the shore of Lake Kontrashibuna, is composed of two mineralized zones that range in altitude from 2,350 to 2,650 feet.

This report contains a brief history of the prospect, description of the physical setting of the property, its geology, and the factual results of the work performed by the Bureau of Mines.

ACKNOWLEDGMENTS

The investigations at Kasna Creek were made by the Alaskan Branch of the Mining Division, under the supervision of G. D. Jermain, Chief.

Analyses of samples were made by H. E. Peterson, chemist, Salt Lake City Branch, Metallurgical Division, Salt Lake City, Utah. Petrographic identifications of rock specimens were made by LaMar G. Evans of the above station. Metallurgical tests to determine the amenability of a composite sample to current metallurgical practices were under the direction of C. H. Schack, metallurgist, Salt Lake City, Utah.

The cooperation of the St. Eugene Mining Corp., Ltd., N.P.L., Vancouver, B. C., holders of the property by option, is gratefully acknowledged.

LOCATION AND ACCESSIBILITY

The Kasna Creek copper prospect is in the Lake Clark region, Southwestern Alaska, about 160 miles southwest of Anchorage, Alaska (fig. 1). The mineralized zone crops out on the right limit of Kasna Creek approximately 2 miles from Lake Kontrashibuna; it can be reached by a narrow, steep trail that starts at the confluence of Kasna Creek and Lake Kontrashibuna (fig. 2).

Access to the area is difficult except by air. The Civil Aeronautics Administration maintains an airport at Iliamna on the north side of Lake Iliamna. Three airlines maintain regular schedules from Anchorage: Alaska Airlines, Northern Consolidated Airlines, and Pacific Northern Airlines.

The passenger rate from Anchorage to Iliamna in 1949 was $44 plus tax; the cargo rate was 6 cents per pound. At Iliamna float planes can be chartered to fly men and equipment to Lake Kontrashibuna. Rates vary from $30 to $60 an hour depending on size and capacity of the plane under charter.

In August 1949, Babe Alsworth completed construction of an air strip at Tanalian Point on Lake Clark that can accomodate a DC-3. From Tanalian Point, it is only 15 minutes by air to the project area.

PHYSICAL FEATURES AND CLIMATE

Lake Clark, one of the largest fresh water lakes in Alaska, heads in the Chigmit Mountains at the base of the Aleutian Range; its surface is 220 feet above sea level. The lake is about 52 miles long and 1 to 4-1/2 miles wide. Lake Clark discharges into Bristol Bay via the Newhalen River, Iliamna Lake, and the Kvichak River.

Kontrashibuna Lake, altitude 560 feet, drains via the Tanalian River into Lake Clark at Tanalian Point. Tanalian Point is on the southeast shore of Lake Clark approximately midway of its length. The Tanalian River provides an excellent opportunity for hydroelectric power. Tanalian Falls, near the outlet of Lake Kontrashibuna, has a sheer drop of 60 feet, and the Tanalian River descends 340 feet in the 4-1/2 miles between Lake Kontrashibuna and Lake Clark. The flow has been estimated at 900 second-feet during medium high water.

Kontrashibuna Lake is well within the western limits of the Chigmit Mountain province and is surrounded by peaks 4,000 to 5,000 feet high. The topography shows the results of recent glaciation. U-shaped and hanging valleys are common. Among the peaks forming the headwaters of Lake Kontrashibuna are numerous alpine-type glaciers. These supply the glacial silt or "milk" that gives the lake its slate-blue color.

The copper prospect is on Kasna Creek, a small tributary to Lake Kontrashibuna. Kasna Creek flows into the lake from the south about 8 miles from the lake's outlet.

The shores of both Kontrashibuna Lake and Lake Clark are covered with a forest of spruce, cottonwood, and birch. Many of the spruce reach sawlog proportions and are suitable for building purposes. At Tanalian Point on Lake Clark, two small sawmills produced lumber for local consumption at $125 per M.

Timberline is from 1,000 to 1,500 feet above sea level. Thickets of alders are interspaced among the larger trees especially along the slopes; in places they make access very difficult. A carpet of mosses, lichens, grasses, and other small plants cover the ground in the forest and at higher altitudes.

The climate in the region is not extreme. The nearest place where weather data has been recorded is at Tanalian Point, where observations have been made for 4 years. The mean annual temperature for the period

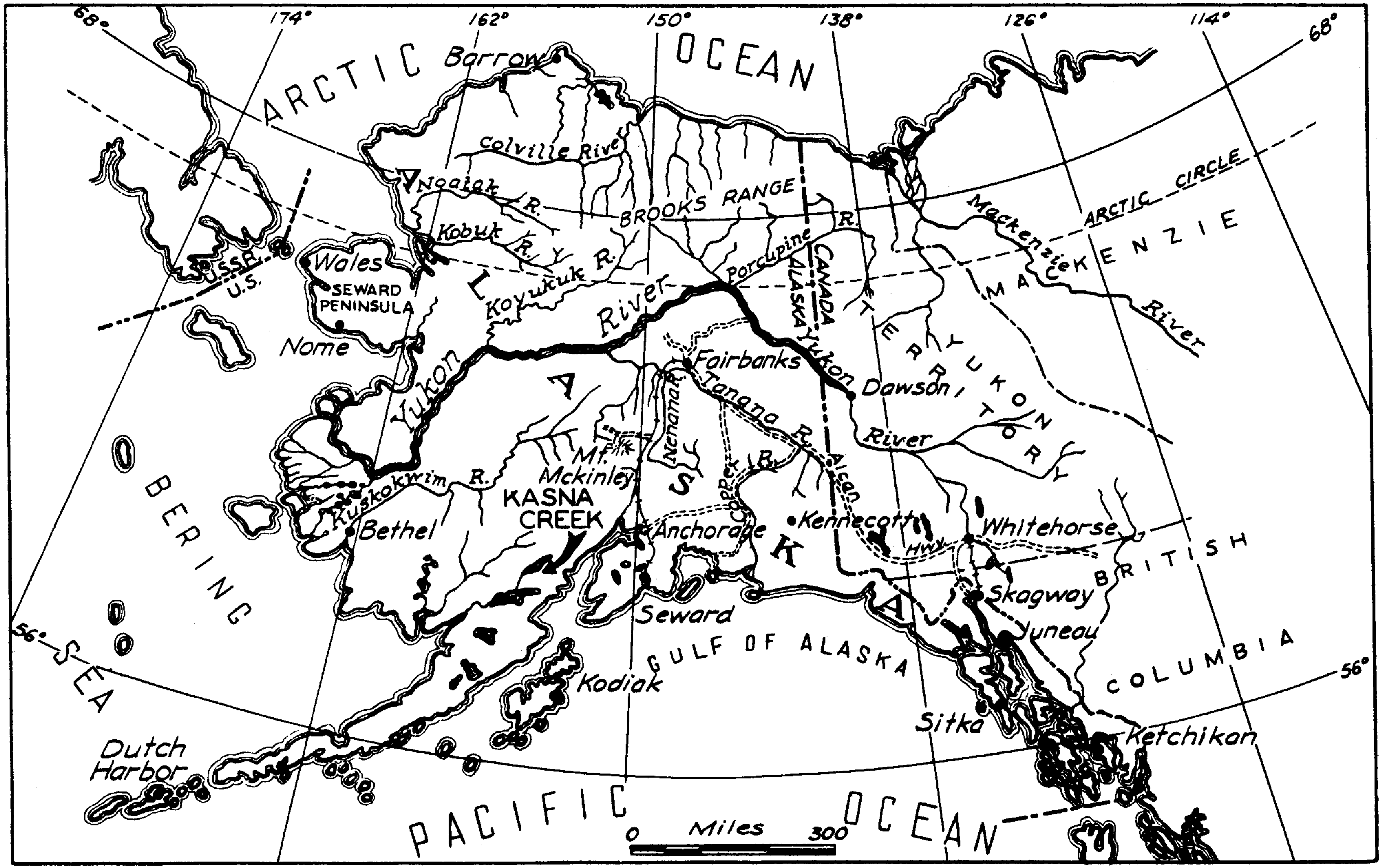

Figure 1. - Index map of Alaska.

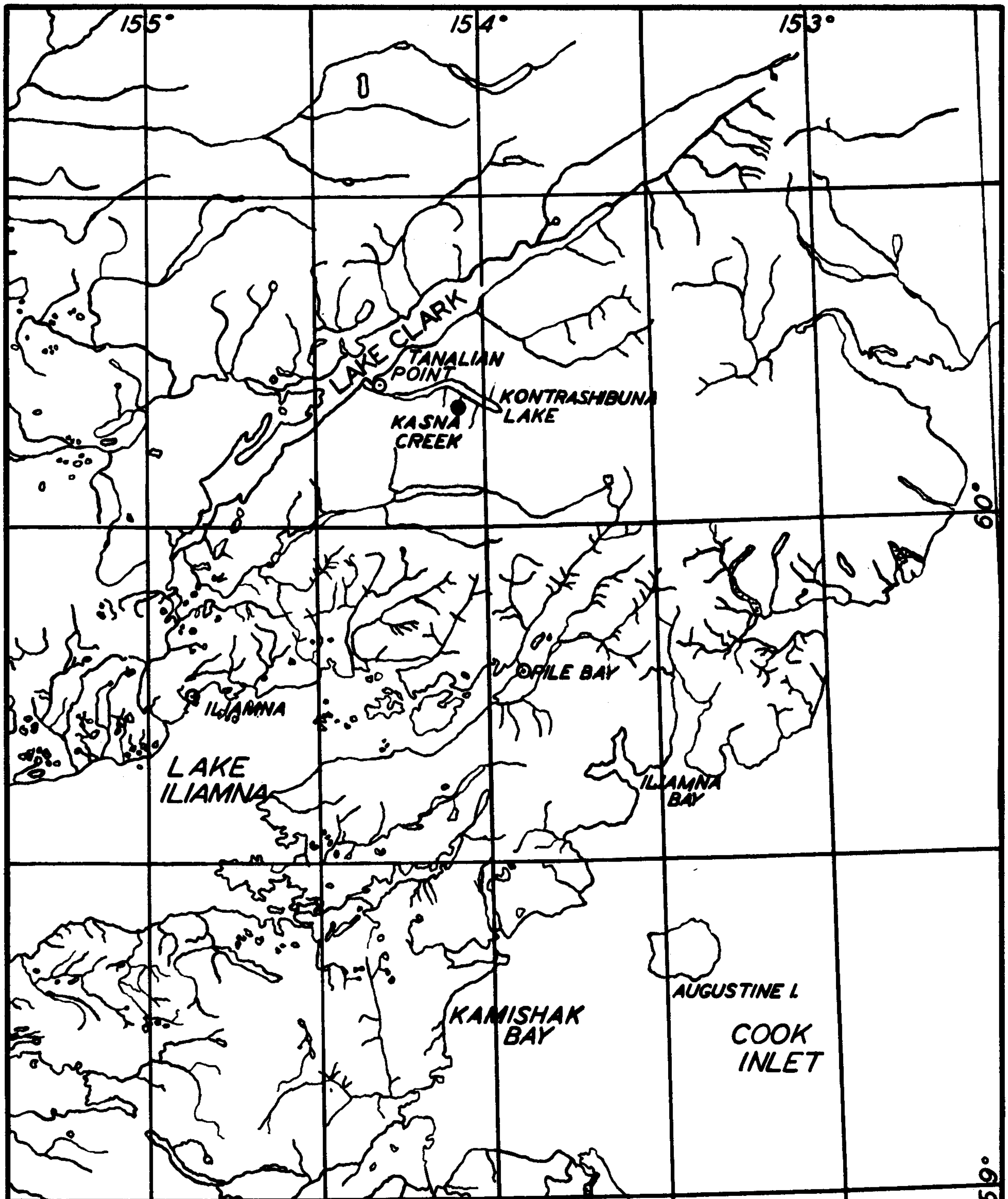

Figure 2. - Location map of Kasna Creek.

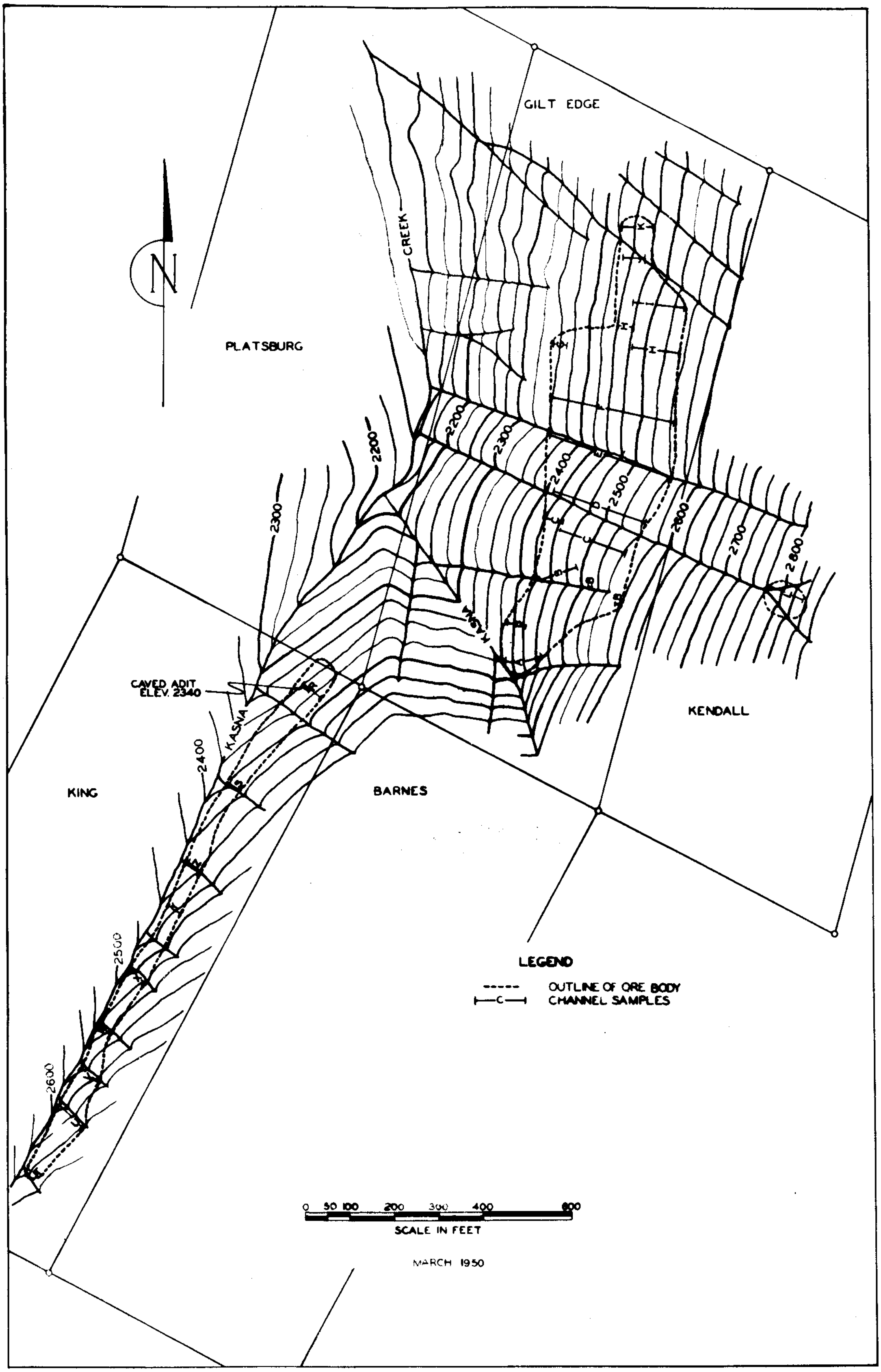

Figure 3. - Topographic and claim map of Kasna Creek copper deposit.

was 31.6° F. Freezing temperatures can be expected from the first of August to the middle of June. Highest and lowest temperatures recorded were 80° F. and -38° F., respectively. The average annual precipitation was 26.68 inches, which included 67.0 inches of snow. Because Kasna Creek is at a higher elevation than Tanalian Point, more snowfall and lower temperatures can be expected.

HISTORY AND PRODUCTION

The initial location of claims covering the Kasna Creek copper prospect was made in 1906 by Charles Brooks and C. von Hardenberg. In 1909 the deposit was visited by a party of the Geological Survey,2/ and the mineral occurrence was first described.

In 1910 the deposit was acquired by Richard M. Edwards of Houghton, Mich. Two examinations were made for him, one by Alexander Legatt, Butte, Mont., in 1911 and one in 1913 by W. R. Crane, Pennsylvania State College, Pa.

Alexander Smith made an examination of the Kasna Creek deposit during the summer of 1943 for the St. Eugene Mining Corp., Ltd., N.P.L., Vancouver, B. C., Canada. The property was later acquired under option by this company.

No production has been obtained from this deposit.

PROPERTY AND OWNERSHIP

The property is in the Iliamna mining district in southwestern Alaska. It consists of the following nine patented mineral claims; Cook, Peary, King, Barnes, Platsburg, Gilt Edge, Kendall, Belle, and Cyanide. The Kasna Creek group of claims were surveyed under U. S. Mineral Survey No. 973, and patent No. 486281 was granted Aug. 10, 1915. Figure 3 is a claim map and general location map of the deposit at Kasna Creek.

The Kasna Creek claims are owned by the Richard M. Edwards' estate. R. L. Edwards, 2303 Ruker Avenue, Everett, Wash., is administrator. In January 1950, the claims were under option to the St. Eugene Mining Corp., Ltd., N.P.L., Vancouver, B. C., Canada.

GENERAL GEOLOGY

The copper mineralization at Kasna Creek is in a limestone belt 1,500 feet wide. The belt of limestone is exposed on both shores of Kontrashibuna Lake and extends to the eastern shore of Lake Clark. Martin and Katz3/ considered this limestone to be Paleozoic, probably Devonian, in age. In their geological maps of the area, the limestone on the south shore of Lake Kontrashibuna is shown in contact on the west with Lower Jurassic porphyries

2/ Martin, G. C., and Katz, F. J., A Geological Reconnaissance of the Iliamna Region, Alaska; Geol. Survey Bull. 485, 1912, p. 121.
3/ Martin, G. C., and Katz, F. J., Work cited in footnote 2, p. 3

and tuffs. The porphyry facies range in composition from acid rhyolites, through quartz porphyries, dacites, and mica andesites to intermediate hornblende andesites. Fine-grained granular rocks, usually with porphyritic texture, are also present. The rock forming the eastern contact with the limestone was not mapped. However, the approximate boundary of the main granite mass forming the core of the Chigmit Mountains is shown 2 miles farther east.

Specimens taken by the Bureau of Mines indicate that the limestone belt is in contact with a rhyolite porphyry on the east and that diorites (?) form the western contact and apparently terminate the limestone on the south. The boundaries of the limestone are in part intruded with small basalt porphyry dikes and sills with which small lenses and veinlets of specular hematite are associated.

The limestone and included mineralized zones strike from N. 15° E. to N. 30° E. and dip 70° to 80° to the northwest.

DESCRIPTION OF DEPOSITS

The Kasna Creek prospect consists of two deposits - the Gilt Edge on the Gilt Edge claim and the Barnes on the King Claim (figs. 3, 4, and 5).

Both deposits are of the contact metamorphic type. Mineralization consists mainly of specular hematite, fibrous amphibole, chlorite, calcite, and quartz. The deposits are not homogeneous; bands of nearly pure hematite, fibrous amphibole, and included altered limestone are present. The bands or lenses are neither continuous nor in any sequence, and the lenses do not follow any recognizable pattern.

Chalcopyrite is disseminated throughout the mineralized area as scattered grains. It also is concentrated in lenses and small veins of nearly pure chalcopyrite. The massive chalcopyrite contains numerous inclusions of sphalerite, which range in grain size from minus-48- to plus-560-(theoretical) mesh.

Both the hanging wall and foot wall of the deposits are composed of fine-grained limestone in which a small amount of quartz and pyrite is disseminated.

The deposits are separated by a small tributary of Kasna Creek. This tributary may mark the trace of a fault; however, it is more likely that the mineralization lensed out at this particular location and that the two ore bodies are separate contact metamorphic deposits instead of faulted segments of the same deposit.

The Gilt Edge deposit (figs. 3 and 4) crops out on the right limit of Kasna Creek, 350 feet east of the creek. The mineralized zone lies along the steep mountain slope paralleling Kasna Creek. It is exposed throughout a strike length of 1.050 feet and a vertical range from 2,350 to over 2,550 feet in altitude. The average width of the deposit is 250 feet. On the south, the deposit starts at the small tributary of Kasna Creek separating the deposits.

Development at the Gilt Edge deposit consists of one adit. This adit was started in the fine-grained limestone, which forms the hanging wall of the deposit, and was driven into the middle of the mineralized zone near the location of trench "E". The tunnel portal is now caved, and consequently the adit is inaccessible.

The second of the main deposits, the Barnes, forms the east wall of the canyon of Kasna Creek throughout most of the length of the King claim (figs. 3 and 5). For over 1,000 feet, the western contact follows along the creek, and the deposit forms a series of cliffs, 20 to 40 feet high. The strike of the deposit then swings about 10° to the east and into the slope of the hill until, at the location of the caved adit near trench "R" (fig. 3), the creek is 80 feet from the edge of the mineralized zone and approximately 60 feet lower.

The Barnes deposit is transected by nine gulleys, which give excellent exposures for sampling. The mineralized zone is 1,340 feet long, averages 50 feet in width, and is exposed throught a vertical range of 330 feet, from 2,335 to 2,665 feet in altitude.

A large proportion of the steep slopes forming the Gilt Edge deposit is covered with talus material. This obscures the outcrop and makes trenching and mapping difficult. Farther to the north on the Cyanide claim, additional mineralization can be traced from exposures in the gulleys. Copper mineralization is very weak, and the zone is not a part of the Gilt Edge deposit. Another adit was started on the Belle claim near the creek level to explore this showing while the required development for patenting was being carried out, but the adit did not penetrate the deposit and is in the hanging-wall limestone for its entire length.

A small mineralized lens crops out on the Kendall claim, 300 feet east of and 225 feet higher in elevation than the eastern border of the Gilt Edge deposit (see figures 3 and 4). This zone is roughly elliptical in shape, with dimensions of 80 and 100 feet.

Two additional claims, the Cook and the Peary, south of the end lines of the Barnes and King claims, have been patented. On one of these, the Peary, approximately 1,200 feet south of the Barnes deposit, is a small zone of pyrite mineralization. This zone was not sampled by the Bureau of Mines; previous sampling indicated that it does not contain copper.

WORK BY BUREAU OF MINES

The Bureau of Mines program of trenching, sampling, and mapping the deposits of copper mineralization at Kasna Creek was begun September 25, 1948. Camp was established at the mouth of Kasna Creek on Lake Kontrashibuna, and a trail was cleared to the deposit. However, only 32 samples could be taken before snow and inclement weather prevented completion of the work; consequently, the project was recessed Oct. 11, 1948. The program was resumed July 15, 1949, and all of the proposed work was completed by Sept. 27, 1949. Covered sections of the deposits were exposed at irregular intervals by approximately 1,225 feet of hand-dug trenches; 417 channel samples, from grooves averaging 1 inch by 3 inches, were cut from the trench bottoms. As taken, each sample represented a 5-foot channel and weighed approximately 9 pounds per linear foot. These were crushed and reduced before shipment to an average weight of 8 pounds per sample. All samples were analyzed for copper and iron. The lay-out of the trenches in the two deposits and the sampling results are shown in figures 4 and 5.

Composites of all samples from each trench were analyzed for gold, silver, lead, zinc, and sulfur; only traces or very small quantities of these elements were found, as indicated by appendix I. Spectrographic analyses were made of composites of each of the deposits, with the results shown in appendix II.

METALLURGICAL TESTS

The average analyses of the Gilt Edge and Barnes deposits are 0.69 and 1.14 percent of copper, respectively. After eliminating the northern lower-grade part of the Gilt Edge deposit, a composite sample of the Barnes and the remainder of the Gilt Edge deposit averaged 0.95 percent Cu, 27.5 percent Fe, and 30.1 percent SiO_2. A summary of the results of beneficiation tests by C. H. Schack, metallurgist, Bureau of Mines, follows:

> A microscopic examination revealed the copper is present as finely crystalline chalcopyrite associated with a gangue composed chiefly of hematite and lesser amounts of magnetite, talc, partially altered pyrite, quartz, and calcite. The hematite occurs as fine needle-like crystals, which are very friable. Grinding to about 200-mesh will be required to liberate the copper from the iron minerals and these minerals from the gangue constituents.
>
> The ore-dressing tests made on the sample included gravity concentration with a spiral, magnetic separator, and a series of flotation tests. The spiral- and magnetic-separation tests were made to explore the possibility of rejecting a low-grade tailing before fine grinding, whereas the flotation tests were made to study the feasibility of making separate copper and iron concentrates after fine grinding.
>
> For the spiral test, the ore was roll-crushed dry to minus-20-mesh and then fed to a spiral concentrator in which a primary concentrate was made. The tailings and middlings from the initial pass through the spiral were recombined and retreated to make a second concentrate, a middling, a sand tailing, and a slime product. The results of this test are given in the following table.

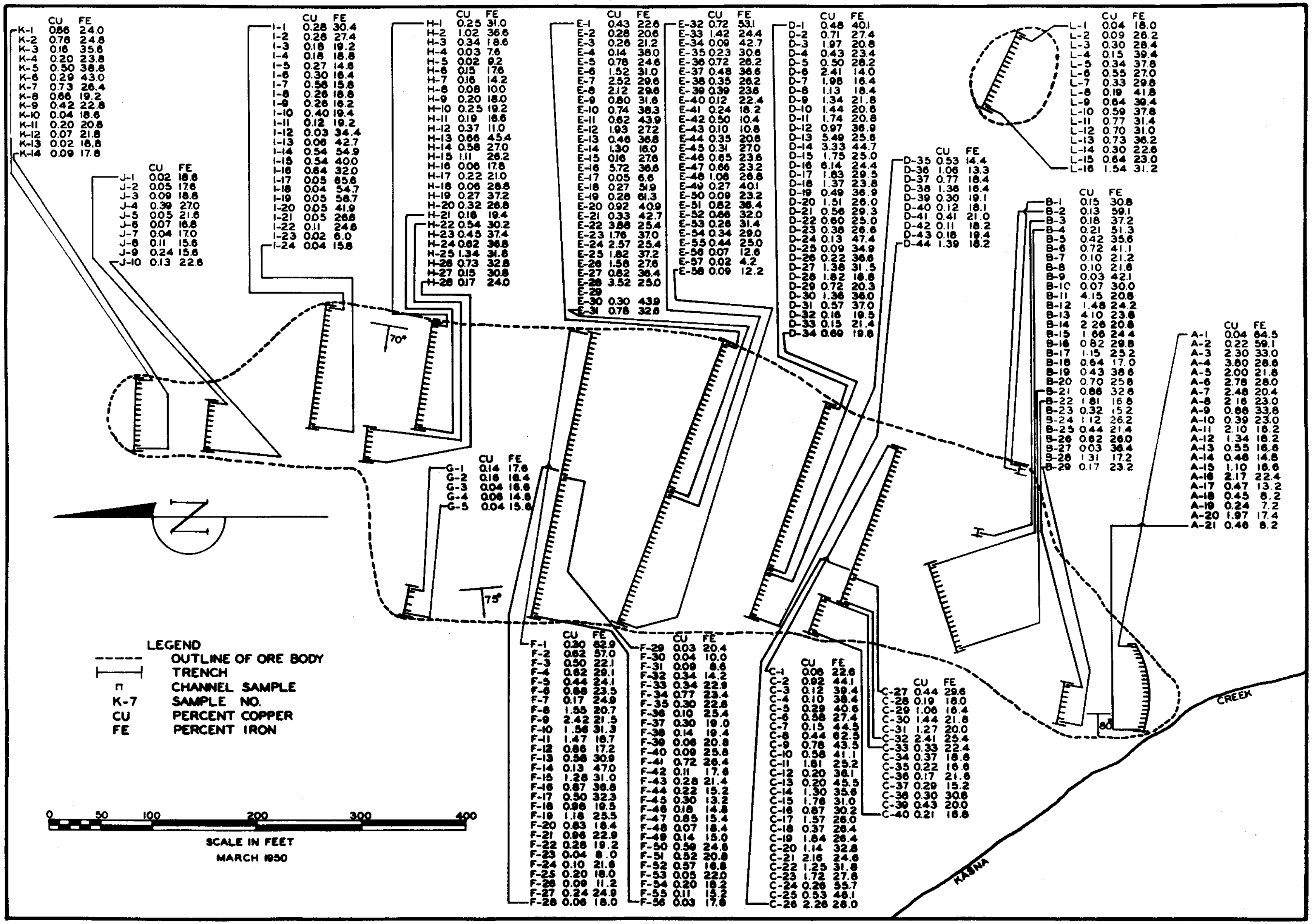

Figure 4. - Assay map Gilt Edge ore body, Kasna Creek.

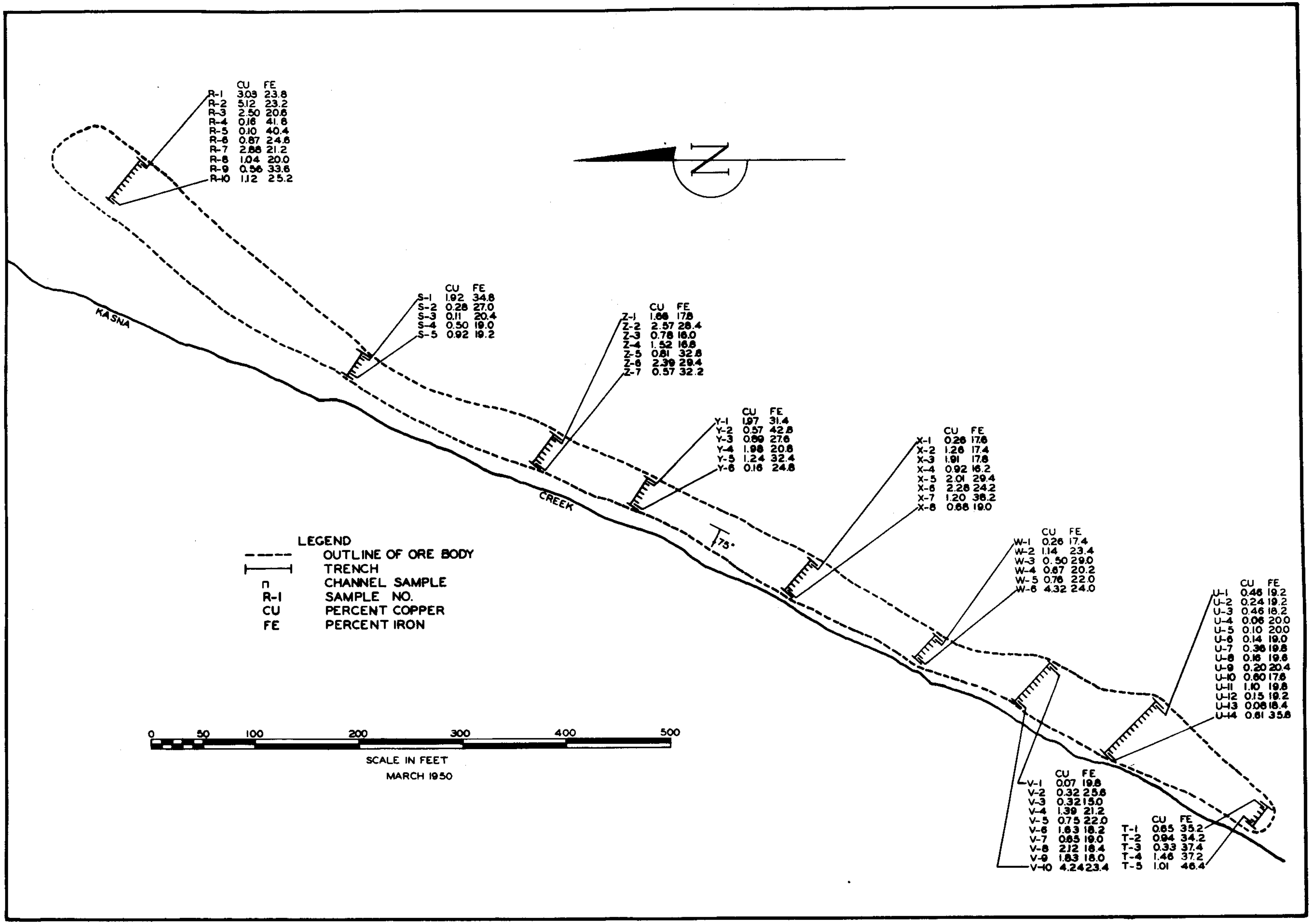

Figure 5. - Assay map Barnes ore body, Kasna Creek.

Spiral concentration,
minus-20-mesh ore

Product	Weight, percent	Assay, percent Fe	Cu	Distribution, percent Fe	Cu
Concentrate 1	52.2	35.6	1.10	66.9	61.7
Concentrate 2	2.8	32.5	1.05	3.2	3.2
Middling	3.0	25.7	.88	2.9	2.9
Tailing	27.0	14.8	.58	14.4	17.2
Slime	15.0	23.5	.90	12.6	15.0
Calculated heads	100.0	27.8	.93	100.0	100.0
Combined concentrate ...	55.0	35.5	1.10	70.1	64.9

The data given show that neither a low-grade reject product nor a high-grade iron-copper concentrate can be made by spiral concentration of ore crushed to minus-20-mesh. The principal reason for the poor results is the lack of liberation between gangue and ore minerals. Appreciable copper and iron also were lost in the untreatable slime fraction.

In the magnetic-separation test, the ore was crushed dry to minus-20-mesh and then screen sized into minus-20- plus-35-mesh, minus-35- plus-65-mesh, minus-65- plus-150-mesh, and minus-150-mesh fractions. Each sized fraction was then passed through a dry magnetic separator twice, with a highly magnetic fraction removed during the first pass and a less magnetic fraction during the second pass. The results were poor; only 45 percent of the iron was recovered as a highly magnetic fraction assaying 49 percent Fe and 0.8 percent Cu. The second magnetic concentrate contained 30 percent of the iron, and 47 percent of the copper in a product assaying 25 percent Fe and 1.3 percent Cu. The nonmagnetic fraction contained 30 percent of the iron and 30 percent of the copper in a product assaying 15 percent Fe and 0.7 percent Cu. The data also showed that the finer the sized fraction treated the cleaner the magnetic concentrate and the lower its copper content. These facts further indicate that poor separation is due chiefly to lack of liberation of the minerals.

Since treatment of the ore at relatively coarse sizes failed to give a satisfactory separation of copper and iron minerals from gangue, a series of flotation tests was made using various grinds and reagent combinations. In these tests, a copper concentrate was floated using first sulfide-mineral collectors and then the iron-oxide minerals were floated using fatty acid-type collectors. However, none of the various conditions tried proved entirely successful in recovering both a copper concentrate and an iron concentrate. When grinds as coarse as 65-mesh were employed, low-grade copper and iron concentrates were obtained and, when finer grinds were used, considerable iron and copper could not be recovered from the large amount of slimes present in such finely ground ore pulps. The results of a typical test are given in the following table.

Flotation of copper and iron minerals, minus-65-mesh grind

Product	Weight, percent	Assay, percent		Distribution, percent	
		Fe	Cu	Fe	Cu
Cu concentrate	3.6	30.0	15.3	3.7	50.5
Cleaned Fe concentrate ..	36.9	33.5	1.0	42.6	33.9
Fe cleaner tailing	46.4	30.9	.3	49.2	12.8
Rougher tailing	13.1	10.1	.25	4.5	2.8
Calculated heads	100.0	29.0	1.09	100.0	100.0

It is noteworthy that no high-grade iron concentrate was made by flotation. This may be attributed to slimy nature of the ore and the poor selectivity obtained with fatty-acid collectors on this type of ore pulp. Only about 50 percent of the copper was recovered in the copper concentrate, which assayed only 15 percent Cu. This product could be upgraded by refloating. It is also possible that a part of the copper in the cleaned iron concentrate could be recovered by regrinding this product and refloating as a microscopic study of the product revealed most of the copper in the product was still locked with the iron oxides.

The facts determined by the ore dressing can be summarized as follows. This type of ore cannot be concentrated by simple methods at relatively coarse sizes. Further, even by fine grinding and flotation, only low recoveries in low-grade copper products are possible. None of the methods tried proved effective for recovering the iron-oxide content of the ore as a separate product.

APPENDIX I. - ANALYSES OF COMPOSITE SAMPLES

Composite sample	Au	Ag	Cu	Pb	Fe	Zn	S
A-1 to A-21, incl.	<0.005	0.2	1.55	<0.1	24.2	0.1	1.54
B-1 to B-2, incl.	< .005	.1	.13	< .1	45.0	.1	.18
B-3	.01	.2	.20	< .1	37.2	.05	.38
B-4 to B-21, incl.	.01	.2	1.11	< .1	30.0	.1	1.03
B-22 to B-29, incl.	< .005	.1	.74	< .1	23.2	.05	1.00
C-1 to C-16, incl.	.01	.2	.64	< .1	38.0	< .05	.55
C-17 to C-32, incl.	< .005	.2	1.24	< .1	29.2	< .05	.99
C-33 to C-40, incl.	< .005	< .1	.28	< .1	20.6	< .05	.34
D-1 to D-22, incl.	.01	.4	1.73	< .1	27.0	< .05	1.67
D-23 to D-44, incl.	.005	.2	.58	< .1	23.8	< .05	.92
E-1 to E-19, incl.	.005	.3	1.09	< .1	32.0	< .05	.91
E-20 to E-38, incl.	< .005	.2	1.24	< .1	34.8	< .05	.92
E-39 to E-58, incl.	< .005	.1	.38	< .1	22.8	< .05	.69
F-1 to F-18, incl.	.005	.2	.86	< .1	31.2	< .05	.85
F-19 to F-36, incl.	< .005	.1	.32	< .1	20.2	< .05	.32
F-37 to F-56, incl.	< .005	.1	.27	< .1	19.4	< .05	.74
G-1 to G-5, incl.	< .005	< .1	.09	< .1	16.2	< .05	.25
H-1 to H-21, incl.	< .005	.1	.30	< .1	22.6	< .05	.33
H-22 to H-28, incl.	< .005	.1	.56	< .1	32.4	< .05	.45
I-1 to I-24, incl.	< .005	.1	.23	< .1	29.6	< .05	.43
J-1 to J-10, incl.	< .005	.1	.12	< .1	19.4	< .05	.19
K-1 to K-14, incl.	< .005	.1	.32	< .1	25.8	< .05	.25
L-1 to L-16, incl.	< .005	.1	.49	< .1	31.2	< .05	.45
R-1 to R-10, incl.	< .005	.2	1.78	< .1	27.8	.05	1.94
S-1 to S-5, incl.	.005	.1	.77	< .1	23.6	.1	.91
T-1 to T-5, incl.	.005	.3	.88	< .1	38.0	.1	1.57
U-1 to U-14, incl.	.005	.1	.34	< .1	20.4	.25	2.09
V-1 to V-10, incl.	.01	.3	1.34	< .1	20.0	.2	4.24
W-1 to W-6, incl.	< .005	.2	1.27	< .1	23.0	.1	2.55
X-1 to X-8, incl.	.005	.2	1.31	< .1	22.2	.1	3.42
Y-1 to Y-6, incl.	.005	.2	1.13	< .1	29.4	.1	3.08
Z-1 to Z-7, incl.	.005	.3	1.47	< .1	25.0	.1	3.21

APPENDIX II. - SPECTROGRAPHIC ANALYSES OF COMPOSITES

Composite	Gilt Edge	Barnes	Composite	Gilt Edge	Barnes
Cu	+	+	Tl	-	-
Ca	+	+	Li	-	-
Mg	+	+	Ru	-	-
Al	+	+	P	-	-
Fe	+	+	Te	-	-
Ni	tr.	Tr.	Be	-	-
Mn	+	+	Ir	-	-
Zn	tr.	Tr.	Ga	-	-
Cd	-	-	Ge	-	-
Hg	-	-	Ba	-	-
Sb	-	-	Cb	-	-
Sn	-	-	Mo	-	-
Pb	-	-	Yt	-	-
Bi	-	-	In	-	-
Ti	+	+	Ta	-	-
V	-	-	Rh	-	-
Si	+	+	Zr	-	-
Na	+	+	Sr	-	-
K	-	-	Cr	-	-
Ag	+	+	W	-	-
Au	tr.	Tr.	Th	-	-
Co	-	-	La	-	-
As	-	-	U	-	-
Pt	-	-	Ce	-	-
Hf	-	-			

Note: + = Present. - = Absent. Tr. = Trace.